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Predicting Geological Engineering Conditions for Constructing Underground Structures in Moscow Area

[Article by G. N. Kharitonenko, L. G. Gordeyeva, Moscow Mining Institute]

[Abstract] Moscow is underlain by calcareous-clayey formations of Devonian and Carboniferous systems with a thickness greater than 1000 m. These formations in many cases are fragmented by a complex system of endogenous fissures sometimes affected by weathering and constitute ground water collectors, which gives rise to complicated situations when tunneling beneath the city since the potential for leakage of water into tunnels must always be taken into account. The water-free massive crystalline limestones and dense clays which occur locally are the most favorable rocks for the construction of underground structures, but they occur only over a small area. Karst formations complicate the problem in some places. In Upper Paleozoic and Mesozoic rocks conditions for the construction of underground structures vary from very complex to relatively simple; the circumstances responsible for these differences, as for other rock complexes beneath Moscow, are discussed in detail. However, there are a limited number of variants of geological engineering conditions which would be encountered in tunneling beneath the city. Seven such variants are defined and discussed. Familiarization of specialists with the geological engineering conditions beneath the city will be aided by this classification, which will facilitate proper selection of sites for tunnels and underground structures, their construction and operation. Figure 1; references: 6 Russian.

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Deep Magnetotelluric Sounding of Aleutian Island Arc

[Article by Yu. F. Moroz, Volcanology Institute, Far Eastern Scientific Center, USSR Academy of Sciences]

[Abstract] It is postulated that a conducting layer is present in the upper mantle of the island arcs. Numerous electromagnetic soundings have been made in such areas, but they are extremely difficult to interpret due to the anomalous effects arising due to redistribution of the electromagnetic field in arc regions. Numerical and physical modeling are required for improving and developing the method. This article gives an interpretation of the magnetotelluric field in the Aleutian island arc, which is in many respects similar to other island arcs. In a first approximation the geoelectric model of an arc is represented in the form of a two-dimensional inhomogeneous model. The model used had an inhomogeneous upper layer underlain by a normal deep section, including a conducting layer in the upper mantle at a depth of 100-170 km. A special program was used in the numerical modeling. An analysis of the two-dimensional model revealed that detection of the upper mantle layer is possible only by using longitudinal curves and the results indicated only limited possibilities of magnetotelluric sounding due to the strong induction effect. Three-dimensional physical modeling of the magnetotelluric field of the Komandorskiye Islands was carried out at the Institute of Applied Problems of Mechanics and Mathematics, Ukrainian Academy of Sciences. The model was fabricated from a concrete plate on which the S map was represented by deepenings. The sea was simulated by a solution of common salt. The necessary S value was governed by thickness of the layer of solution. A metal plate with a given resistivity was placed at the base of the model for simulating the upper mantle layer. The results of the modeling indicated that with a change from a two- to a three-dimensional model the S and induction effects are substantially reduced. In the three-dimensional model there is a lesser distortion of the longitudinal and transverse magnetotelluric sounding curves. The longitudinal curve is more suitable for studying the geoelectric section. These modeling data were used in interpreting deep magnetotelluric soundings carried out on Bering Island using a range of periods from 2500 to 15,000 s (five-day continuous record of five electromagnetic field components). It is concluded that beneath the western flank of the Aleutian arc the conducting layer is at a depth of about 90 km and its total conductivity is about 7000 rho. A close result was obtained in eastern Kamchatka, indicative of a similar thermal regime. Figures 3; references: 3 Russian.

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Possibilities of Interpreting Magnetotelluric Soundings From Phase Curves

[Article by V. G. Sekriyeru, G. V. Molochnov and Yu. N. Kozulin, Leningrad University imeni A. A. Zhdanov; Kishinev University imeni V. I. Lenin]

[Abstract] In contrast to commonly used procedures, a more graphic representation of the geoelectric section $\rho(h)$ in magnetotelluric sounding can be obtained by using the dependence of these parameters on the effective depth of penetration of the electromagnetic field. In addition, it is possible to interpret magnetotelluric sounding data from special graphs in the field without invoking complex interpretation procedures. These new findings encouraged research along these lines in the example of two- and three-layered media. The cases ρ_2 is less than ρ_1, ρ_2 is greater than ρ_1 and ρ_2/ρ_1 are examined. Four types of three-layered medium are described. An

analysis of these different variants indicates that the use of phase curves together with amplitude curves for interpreting the results of magnetotelluric sounding data for obtaining information on the geoelectric section in the field is feasible. The method outlined in the article for constructing phase curves and determining the thickness of layers gives quite good results. Figures 5; references 7; 6 Russian, 1 Western.

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Principal Problems in Upgrading Quality and Efficiency of Geological Survey Work

[Article by D. S. Bulayevskiy, V. A. Velikanov, D. F. Volodin, A. S. Drannik, V. N. Solovitskiy and A. A. Frayberger, Geology Ministry, Ukrainian SSR, Kiev; Geophysical Division, Ukrainian Geological Prospecting Scientific Research Institute, Kiev; Geological Sciences Institute, Ukrainian Academy of Sciences, Kiev]

[Abstract] A National Geological Map at 1:50,000 in now in preparation. This has made it necessary to reexamine the status of geological surveying in the Ukrainian SSR (100% covered at 1:200 000 and 49% at 1:50,000). In many areas the upper horizons have been studied to a much better degree than the deeper horizons, although the latter afford the best possibilities for detecting new mineral deposits. This article summarizes materials collected during the last 13 years on geological survey work done in the Ukrainian SSR. This includes the work of 80 survey parties and detachments. The types of work done and its adequacy are discussed in detail. This is followed by a discussion of some of the gaps and inadequacies in this work. For example, inadequate use of aerospace surveys has had a negative effect on the quality of geological maps. Despite their importance, annular structures have been virtually neglected on geological maps. Although a number of geological surveying manuals have been prepared, they have not been adequately used in many cases. Much field work is done with an inadequate level of competence; for example, little use is made of mathematical methods because workers have little training in their use. Computer illiteracy is the rule rather than the exception. Although the feeling has developed that the possibilities of the sedimentary mantle are fully known, continuing work has revealed the presence of important concentrations of phosphorites, titanium and construction materials. Taking into account the acute needs for water by the population, agriculture and industry, geological survey work should be accompanied by hydrogeological research, but in many cases no time or funds are allocated for this purpose. Geological prospecting work in general is held back by various organizational shortcomings, including shortages of trained personnel. Drilling is an important aspect of such work, but many instances of incompetence have occurred. Although there have been many examples of successful cooperation among agencies, in other cases work has suffered due to lack of proper contact between geologists and other specialists. Whereas during earlier five-year plans work was concentrated on the Ukrainian shield, in the Donbass and in the Ukrainian Carpathians, the emphasis should now shift to geological mapping of the Dnepr-Donets Basin. Analysis of already available materials will make it possible to find commercial deposits of titanium and nonore minerals and construction materials. It is essential that the Dnepr-Donets area be regionalized as an aid in defining priorities for geological survey work. References: 6 Russian.

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'Mir' Abyssal Manned Vehicles

[Article by I. Ye. Mikhaltsev, doctor of technical sciences, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences]

[Text] On 17 December 1987 the Acceptance Commission, USSR Academy of Sciences, signed a document marking the completion of tests and acceptance of a research complex of two self-contained abyssal manned vehicles: "Mir-1" and "Mir-2," with a rated depth of submersion in the ocean of 6000 m. Their construction is the result of successful Soviet-Finnish cooperation. The vehicles were designed and constructed by the Finnish company Rauma-Repola in conformity to the technical specifications and under the scientific direction of the USSR Academy of Sciences; the author of this article was the scientific director of the work.

The construction of the "Mir" vehicles and the research complex as a whole is a major event in modern technical oceanology. Their construction has afforded fundamentally new possibilities for abyssal research in the ocean. It must be noted at once that until now there have been only two vehicles in the world capable of submerging to a depth of 6000 m. These are the "Sea Cliff," belonging to the US Navy[1], constructed in 1984, which has not yet been used for research in the world ocean under any fundamental research program, and the French "Nautilus," constructed in 1985, which on a joint French- Japanese expedition was used in carrying out interesting biological and geological research at depths as great as 5900 m in the neighborhood of the Japanese trench[2].

The rated depth of 6000 m for underwater vehicles is selected as a reasonable desirable limit because only about 1 percent of the world ocean floor area remains inaccessible for research. About 20 years ago the concept of the need for the man-observer to approach the object of study was formulated at the Oceanology Institute, USSR Academy of Sciences. In the mid-1970's, at a small Canadian company, we were able to construct two "Paysis" vehicles with a submergence depth as great as 2000 m. Work with these vehicles became widely known throughout the world[3]. Research in the ocean depths is today unthinkable without the participation of a man-observer supplied with indicators of many measuring instruments, photographic and video recorders. In this sense the experience of work in space is also extremely instructive.

Our new abyssal vehicles are completely identical with respect to their technical specifications and capabilities. They are designed for the work of three men: one or two pilots and one observer-researcher. The life support systems enable the crew to work for three and one-half days; technically this time can be at least doubled, although the proposed normal effective cycle (submergence, work and surfacing) is not more than 12 hours. The vehicles have a power supply of 100 KW x hour and a maximum rate of underwater movement of 5 knots, in both cases twice as great as for foreign vehicles. These parameters are especially important in areas of complicated relief and strong currents. An important advantage of the "Mir-1" and "Mir-2" vehicles is a virtually unlimited capability for vertical maneuvering, which both the "Nautilus" and "Sea Cliff" lack.

The "Mir" vehicles are outfitted with the entire range of oceanological measuring systems (other than gravimetric). Temperature, conductivity, static pressure, the three components of streamline flow, speed of sound and transparency are measured. A two-range instrument for measuring radiation characteristics, an instrument for measuring the temperature gradient in layers of sedimentary rocks and a three-component magnetometer are carried aboard; it is possible to register pH and pO, as well as any other parameters in the 8 free channels in the data collection system. The vehicles have two wide-format cameras forming a stereophotogrammetric system, a highly sensitive (1 lux) color television system with high-quality registry (in the BETACAM standard) and a black-and-white video system with a sensitivity 0.1 lux. Two manipulators with seven degrees of freedom make it possible to collect samples weighing up to 80 kg in the water. A system of lights casting light with different spectral parameters and a searchlight with two axes controllable from the vehicle ensure optimal conditions for video and photographic registry and also a view for the observers through large ports (the clearance for the central port is 200 mm, for the two side ports, 120 mm; the largest ports in foreign vehicles have a diameter of 120 mm).

In a brief communication it is impossible to enumerate all the merits of the vehicles which could be examined. Such essential characteristics of the quality of the vehicles (all other conditions being equal) as their weight in the air and load-lifting capacity from the bottom) (buoyancy factor) are of interest. The "Mir-1" and "Mir-2" vehicles, which are outfitted with efficient Fe-Ni storage batteries, each weigh about 18.6 tons, equal to the weight of the "Nautilus" (the "Sea Cliff" weighs 29 tons). However, if the power supply of our vehicles is equated to the French vehicle, the weight of each would become only 17 tons. The load-lifting capacity of our vehicles from the bottom is 300 kg, which is 100 kg greater than for the foreign vehicles.

Two other considerations are of more than a little importance: one applies to the reliability of the vehicles and the other applies to the time required for their construction and cost. In our opinion the reliability of the "Mir" vehicles was demonstrated by the fact that directly after factory tests the vehicles underwent delivery tests in the ocean at different depths, including the maximal admissible depth. An international crew, consisting of P. Laakso, senior pilot in charge of delivery

(Finland), A. M. Sagalevich (USSR), senior pilot in charge of acceptance, deputy director of the work, and the author, director of the dives, successfully carried out tests in the Central Atlantic, attaining a depth of 6170 m in the "Mir-1" vehicle on 13 December 1987 and 6120 m in the "Mir-2" on 14-15 December. As a comparison we note that the "Sea Cliff" approached its record depth at 6000 m in 11 months; the French vehicle also required several months in order to reach its limiting depth.

The time for constructing the "Mir" vehicles was unprecedently short: less than two and one-half years from the beginning of design work to completion of the tests. With respect to the cost of one vehicle, in concluding the contract it already took into account the participation of the USSR Academy of Sciences and was somewhat lower than the known cost of similar foreign vehicles. However, by implementing the purely technical proposals of the USSR Academy of Sciences it was possible, without altering the specified qualities of the vehicles, to reduce the cost of each of them substantially.

A planned expedition on the "Akademik Mstislav Keldysh" scientific research ship of the USSR Academy of Sciences, involving use of the abyssal manned vehicles "Mir-1" and "Mir-2," began on 19 February 1988.

The expedition is to run three months and is being carried out in the rift zones of the Central Atlantic.

Footnotes

1. "New Abyssal Vehicle," PRIRODA, No 7, p 117, 1986.

2. Also see: "Abyssal Research in the Nankai Trench," PRIRODA, No 10, pp 117-118, 1986.

3. For example, see: Kuznetsov, A. P., Sagalevich, A. M., Bogdanov, Yu. A. and Podrazhanskiy, A. M., "In the Rift Zone of the Reykjanes Ridge," PRIRODA, No 8, pp 35-41, 1985.

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Stationary Power Spectra of Two-Dimensional Turbulence in Single-Layer Ocean With Free Surface on beta-Plane

[Article by R. S. Iroshnikov, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences]

[Abstract] The fundamental concept used in any phenomenological description of turbulence is that system evolution is irreversible and that it more or less rapidly "forgets" everything other than its integrals of motion,
additive in the phase space in which the Liouville theorem is correct. This "forgetfulness" can be identified with the relaxation time stipulated on the basis of an evaluation of the terms of dynamic equations, or in the case of slight nonlinearity, a kinetic equation. A model kinetic equation in partial derivatives satisfying the laws of conservation of energy and enstrophy is proposed for describing the spectrum of two-dimensional turbulence; the energy and enstrophy flows are considered equal to zero in a state of thermodynamic equilibrium. It is shown that the β-effect and the presence of a free surface exert an influence on evolution of total energy only due to the dependence of relaxation time on them. Stationary spectra of the Kolmogorov type were found for four cases: for large- and small-scale "eddy" and "wave" turbulence. References 10: 9 Russian, 1 Western.

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Experimental Research on Low-Frequency Acoustic Fields in Ocean and Evaluation of Possibilities of Predicting Their Characteristics

[Article by D. I. Abrosimov, V. S Averbakh, L. S. Dolin, P. A. Kapustin, A. G. Luchinin, V. N. Nekrasov, A. G. Nechayev, L. A. Ostrovskiy, Ye. A. Plakhin, A. M. Podrazhanskiy, M. M. Slavinskiy, A. M. Sutin and B. N. Filyushkin, Applied Physics Institute, USSR Academy of Sciences, Gorkiy]

[Abstract] There are still many important problems relating to the spatial-temporal structure of oceanic wave guides, both in the case of direct propagation and with scattering from wave guide inhomogeneities. Research was carried out to ascertain whether on the basis of theoretical computations based on relatively rough data on sound channel properties which can be measured experimentally it is possible to predict real experimental data relating to important signal characteristics. The experimental data were collected aboard the "Akademik Mstislav Keldysh" and "Dmitriy Mendeleyev" in the Pacific and Indian Oceans on four tracks 600 to 1500 km in length characterized by different types of underwater sound channels. The spatial and temporal structure of the direct signal and distant reverberation signals were analyzed for these different circumstances. Evidence was obtained that reverberation developed as a result of sound scattering by the sea floor and nonuniformities of the speed of sound generated in the near-surface layer of the ocean by small-scale turbulence. Comparison of theoretical computations and experimental results indicated that the characteristic values of the level of distant reverberation signals can be predicted with an error of about 10 db. Surface reverberation was never reliably observed. The experiments confirmed that despite strong low-frequency variability of parameters along the track and positioning of the receiving and radiating antennas the direct and scattered signals during their

propagation remain quite stable even at distances greater than 1000 km. Theoretical computations correctly describe the averaged situation, making possible their use for predicting field structure, important, for example, in acoustic tomography problems. Figures 4; references 8: 7 Russian, 1 Western.

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Spectral Fluxes of Enstrophy and Energy in Self-organization of Turbulence

18650152a Kiev MORSKOY GIDROFIZICHESKIY ZHURNAL in Russian No 3, May-Jun 88 (manuscript received 5 May 87) pp 9-14

[Article by A. B. Fedotov, Marine Hydrophysics Institute, Ukrainian Academy of Sciences]

[Abstract] A detailed analysis of the spectral flows of enstrophy and energy in a regime of self-organization of two-dimensional turbulent motion is presented. It is demonstrated that in the generation of strong eddies the coherent correlation of the phases of Fourier harmonics ensures stability of the eddies relative to the turbulent cascade of entrophy and the decay of eddies is related to the intensive radiation of Rossby waves. A feature of such radiation is a decrease in the degree of anisotropy of the vorticity and stream function fields. The described characteristics of evolution of eddy fields in a self-organization regime are significant for the practical detection of strong localized coherent eddies. The observed process is a dynamically nonstationary process. The intensity of the nonlinear interactions remains unchanged in all stages (of generation and decay) of eddies, as well as in the intermediate stage of turbulent evolution. The strongest nonlinear transport occurs in the region of powerful eddies, not in the ambient background. These are dynamically nonstationary eddy formations which as a result of phase correlations are long-lived. The strong nonlinear interactions in the neighborhood of the eddies exhibit a fundamental difference between the studied formations and eddies of the soliton type. Figures 4; references 4: 2 Russian, 2 Western.

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Numerical Experiments for Monitoring Hydrophysical Processes in Gulf of Lions Using Data From Contact and Remote Measurements

18650152b Kiev MORSKOY GIDROFIZICHESKIY ZHURNAL in Russian No 3, May-Jun 88 (manuscript received 9 Jun 87) pp 46-51

[Article by V.M. Talanov and I. Ye. Timchenko, Marine Hydrophysics Institute, Ukrainian Academy of Sciences]

[Abstract] A study was made of the accuracy in retrieval of hydrophysical processes in a test range in the Gulf of Lions. The region was chosen due to the availability of observational data collected in July-August 1976 in a joint Soviet-French project with two ships, a so-called buoy laboratory and three ordinary buoys, supplemented by two surface temperature field surveys from the "NOAA-4" satellite. The "Akademik Vernadskiy" scientific research ship made two hydrological surveys. A total of 63 stations were occupied in the test range, which measured 60 x 80 miles. The objective was to assimilate data from the "Akademik Vernadskiy," the French survey ship, the buoys and satellite. The four-dimensional analysis method which was developed (the algorithm is described in detail) proved successful in simultaneous assimilation of both contact and remote observations. With the volume of data available it was possible to monitor the density and temperature fields with a satisfactory accuracy. Although there were considerable errors in retrieving the field of horizontal velocities, in amplitude they did not exceed variations of the field itself. Adjustment of the exchange coefficients in the equations of the numerical model resulted in an appreciable increase in the accuracy of monitoring of the hydrophysical fields. Figures 4; references: 4 Russian.

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Methods for Computing Wind and Waves in Tropical Hurricanes

Obninsk GIDROMETEOROLOGIYA. SERIYA 37.25. OKEANOLOGIYA. NO 1. METODY RASCHETA VETRA I VOLN V TROPICHESKIKH URAGANAKH in Russian 1988 (signed to press 22 Apr 88) pp 1-48

[Monograph by K. V. Pokazeyev and M. Yu. Tyurikov, All-Union Scientific Research Institute of Hydrometeorological Information-World Data Center, Informatsionnyy tsentr VNIIGMI-MTsD, 48 pages, 352 copies]

[Abstract] This review discusses methods for the collection of information on wind and waves in tropical hurricanes and methods for their computation. The most promising methods for collecting data on wind and waves in hurricanes are described. A classification of methods for computing wind and waves is proposed. The most modern and frequently used methods are described in detail and are compared. It is clear that further improvement in methods for computing the wind will involve development of more modern multiparameter models which describe in detail the wind fields in tropical cyclones and their evolution. Such development is being delayed by the limited number of reliably determined wind field parameters. Advances can be made only after broad use of remote methods for measuring the characteristics of the near- water atmospheric surface layer. The development of existing physical models of the near-water layer in hurricanes is affording significant possibilities, although it requires establishing relations describing interaction between the air flow in a tropical cyclone and the wave spectrum. Spectral methods are the most complete and physically sound among existing methods for computing waves in hurricanes, but the following problems must be solved: development of an economical numerical method for

solving the wave energy balance equation; adequate description of the energy flow to waves in the case of high wind speeds and wave energy dissipation; development of reliable parametrization of integral nonlinear interactions, taking cases of spectra of mixed waves into account; development of a method for describing the angular distribution of wave energy under conditions of a rapidly changing wind field. The use of complex spectral methods for computing waves is feasible only in cases when there is excellent information on the wind field available, otherwise spectral models have no significant advantages over simpler empirical models. Wind-wave measurements in tropical cyclones have been inadequate. A scheme for computing wind and waves in tropical cyclones is proposed which can be used for computing winds and waves in individual hurricanes and for computing the characteristics of winds and waves caused by tropical hurricanes. Figures 3; references 73: 19 Russian, 54 Western.

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Statistical Correlations of Hydrometeorological Parameters of Norwegian Sea and Adjacent Regions of North Atlantic

[Article by P. Ye. Shirokov, Leningrad]

[Abstract] Since it is important to evaluate the degree of consistency of long-period variations of hydrometeorological characteristics in different energy-active zones in the ocean (EAZO), a study was made of the qualitative uniformity and synchronous nature of climatic variability in the Norwegian EAZO and in adjacent areas of the Atlantic sector of the northern hemisphere. Significant correlations were found between the mean seasonal values of hydrometeorological characteristics (Ta (sea surface temperature), Tw (air temperature), V (velocity), R-(P+LE) (resultant heat flow)) registered at different weather ships (A, C, D, I, M), as well as the correlations of mean seasonal and mean annual values of hydrometeorological characteristics of weather ship M and other weather ships (for winter, spring, summer, autumn and the year). Significant asynchronous correlations were found for series of mean seasonal values of hydrometeorological parameters displaced relative to one another. In many cases, for example, changes at weather ship M lagged relative to changes of the corresponding parameters at other weather ships. Such data can be used in preparing long-range predictions for the Norwegian Sea. The correlation coefficients between time-spaced series in many cases are higher than between synchronous series. For example, a statistical analysis for weather ship M indicated that series of mean seasonal R-(P+LE) values significantly correlate with winter, spring and autumn Ta values, whereas for mean seasonal Tw series such correlations do not exist. These types of correlations are promising as one of the possible methods for the parametrization of R-(P+LE) values on the basis of Ta and Tw data which can be obtained by remote methods. Figure 1; references 8: 6 Russian, 2 Western.

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Annular and Block-Folded Structures on Space and Aerial Photographs

[Article by A. A. Bayramov, Kh. S. Mirzabekov and A. Z. Abdullayev, Azerbaydzhangeologiya Production Association]

[Text] The basin of the middle course of the Terter River, where the Kyzylbulakh ore field is located, is one of the regions in the Lesser Caucasus which has been studied in detail. It has long attracted the attention of researchers due to the presence of favorable lithological-structural conditions for the localization of different genetic and morphological types of ore mineralization. These include the Kyzylbulakh copper pyrite ores deposit, the Yeradzgyumer copper magnetite ores deposit of a stratiform type, the Aryutyungomer sulfur pyrite show, Zapadno-Mekhmanin vein of polymetallic ores and ores of other mineralized points. The increased interest in this territory is not by chance, as is indicated by the concentration of geological survey and exploration work here.

According to the concepts of most researchers, the basin of the middle course of the Terter River is the point of joining of the Agdam anticlinorium and the northwestern part of the Martunin synclinorium (on the right bank) and the Toragaychay synclinorium (on the left bank). The most ancient deposits are the volcanogenic-tuffogenic deposits of the Bathonian stage, cut by subvolcanic intrusions of liparitic-dacitic porphyries of Late Bathonian age. The synclinoria were formed by Cretaceous-Upper Jurassic deposits. The latter were cut by granitoid intrusions of Late Jurassic-Early Cretaceous age. The structural boundary of the Agdam anticlinorium with the Toragaychay-Martunin synclinorium is the Agdam upthrow fault with a dip of the fault fissure to the north at an angle of 30-60° with an amplitude 1000 m. Transverse as well as longitudinal faults have been detected.

On the basis of geological observations and also a detailed study of space photographs and aerial photographs at different scales the authors detected a great many large fragments of Upper Jurassic limestones, displaced in the direction of the Terter River floodplain, and thick alluvial-talus formations filling the Aterk accumulative basin. Certain interesting data were obtained which make it possible to reexamine the earlier prevailing concepts concerning the geological structure of the Kyzylbulakh ore field and adjacent territories. Two systems of structures, folded and annular, are noted in the interpretation of space photographs and high-altitude aerial photographs. The first of these, also mappable by surface observations, have a linear-block structure. However, the interrelationships between the linear folds of Caucasus strike and transverse structures and the kinematic features of most of the longitudinal and transverse faults, that is, the rank hierarchy of blocks

falling between differently oriented faults, their absolute and relative levels, are not always clear. Annular structures have been detected for the first time. According to new data, they play a significant role in the distribution of intrusive bodies and ore deposits. The annular structures, although not expressed in the relief, are isolated due to intensive fissuring of the rocks. Faults cutting the annular structures have been detected on large-scale space photographs: some without dislocation and others without dislocation in vertical and horizontal directions. It can be concluded on the basis of what has been said that the faults are recent relative to the annular structures.

A study of the blocks and folded structures detected on the photographs shows that the first are a component part of the second. The different hypsometric levels of the blocks give rise to the longitudinal undulation characteristic for the point of joining of the Toragaychay and Martunin synclinoria and the local structures which are part of them: the Susuzlukh and Agdag synclinal and Benevshelin anticlinal zones on the left bank of the Terter River (E. Sh. Shikhalibeyli, 1966) and Martspan Cretaceous and Dovshanlin Upper Jurassic synclines, and also the Chldran Middle Jurassic anticline separating them. Erosion has revealed Lower Bathonian volcanogenic-tuffogenic formations in the deep canyon of the river.

A block structure is expressed quite clearly in the Middle Jurassic formations, cut by longitudinal and transverse faults (Figure not reproduced.). The following pattern was established in the positioning of blocks in the longitudinal folded structures: with advance in the direction of the Terter River channel the blocks drop down in steps along the synclines and are uplifted in the anticlines. For example, the Drambon block, within whose contours an annular structure of the same name is situated, is downdropped 300-400 m relative to the Martspan block, including the Cretaceous trough of the same name. Upper Bathonian tuffogenic deposits and Upper Jurassic tuffogenic formations and limestones, which are cut by intrusive bodies of different petrographic composition (granodiorites, quartz diorites, gabbro-diorites, diabasic porphyrites, etc.) and different morphology (small stocks, dikes and stratal injections), caused by intensive hydrothermal modification of the country rock, participate in its geological structure. The Drambon annular structure, clearly defined on space and aerial photographs, has a diameter of about 2 km. On the ground it is defined somewhat conditionally from the arcuate arrangement of magmatic bodies (outer outlines) and the concentration of small stocks of intrusive formations in its central part. On the northwest the annular structure is cut by the Pravoterter transverse fault, along which part of it has dropped down and is not detected within the limits of the Sarkhang block.

The downdropped Sarkhang block is pressed between the Levo- and Pravoterter transverse faults, situated at equal distances (about 0.5 km) from the Sarkhang Reservoir. A considerable part of this block is hidden by

Quaternary alluvial and talus-proluvial deposits, including different sizes of fragments of volcanogenic and calcareous rocks. Volcanogenic formations of the Bathonian, penetrated by stratal intrusions of diabasic porphyrites, are exposed in individual sectors beneath Quaternary deposits.

The Umudlin block is discriminated to the northwest. A considerable part of this block is covered by thick talus with large landslip blocks of various kinds of rocks. The Martspan, Drambon, Sarkhang and Umudlin blocks form the Martspan-Umudlin longitudinal zone which is part of the northern branch of the Toragaychay-Martunin synclinorium. On the northeast it is cut by the Agdam overthrust; on the southwest it is bounded by the Prtogaget fault. On space and aerial photographs both faults are traced quite clearly, but the second of these is poorly expressed in the terrain and its existence can be judged on the basis of indirect criteria.

The Aterk-Kochogot longitudinal zone, also cut by transverse faults and consisting of blocks of different sizes, is situated to the southwest of the Prtogaget longitudinal fault. It coincides spatially with the Chldran anticlinal uplift formed by Middle Jurassic volcanogenic formations. In the middle part of this zone is the Kyzylbulakh annular structure, consisting of two rings of highly fissured rocks. Both rings can be seen clearly on space and aerial photographs. The outer ring has an ellipsoidal configuration with axes of 4 and 2.5 km respectively. The inner ring, with axes of 2 and 1.5 km, lies between the Levo- and Pravoterter transverse faults. In the northwest both rings are concealed beneath Quaternary alluvial, talus-proluvial formations. In the southeast volcanogenic formations of Middle Jurassic age, cut by Upper Bathonian subvolcanic intrusions of liparitic-dacitic porphyry (A. A. Bayramov, 1967) and small stocklike gabbro-diorites of Late Jurassic- Early Cretaceous age, are exposed from beneath the Quaternary cover.

The Kyzylbulakh chalcopyrite deposit is associated with the juncture of the Drambon and Kyzylbulakh annular structures and therefore a structural ore localization factor is established. It can serve as a basis for prospecting for similar ores using the presence of annular structures as a criterion. We suggest the northern margin of the Drambon annular structure (Figure not reproduced.) as an area for prospecting. The legitimacy of this proposal is confirmed by our surface observations which revealed a well-developed zone of hydrothermally modified rocks with copper mineralization (the possibility of the presence of other genetic types of ores here is not precluded). The southern margin of the Kyzylbulakh annular structure should also evidently be assigned to the category of promising areas since a show of copper ores of the impregnated-veinlet type is known there.

We defined the next longitudinal zone to the southwest, situated between the Aterk and Vaga iz faults, as the Agdaban zone. It has been studied poorly in comparison with the other longitudinal zones, but the presence of an annular structure on the left bank of the Terter River at Imarat-Karvend village makes it possible to suggest it as an area meriting reconnaissance. The presence of granitoid intrusions of Late Jurassic-Early Cretaceous age and liparitic-dacitic subvolcanic intrusions of Late Bathonian age in the region of the Agdabanchay River basin is evidence of good prospects for the Agdaban annular structure.

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Attenuation and Absorption of Radiation by Optically 'Soft' Cylindrical Particles

[Article by V. V. Kuznetsov and L. N. Pavlova, Experimental Meteorology Institute]

[Abstract] There has been no precise solution of the problem of attenuation and scattering of radiation by aspherical particles of a finite size and arbitrary configuration. It has been necessary to use approximate methods which when applicable have given quite precise results. Some such methods exist for particles with a refractive index close to 1, so-called optically "soft" particles. However, it is of practical importance to consider particles whose size is commensurable with or exceeds the wavelength of incident radiation because they largely determine radiation attenuation in a turbulent medium. In the case of "soft" particles the ray is almost not refracted and is not reflected by a particle. In solving this problem the anomalous diffraction approximation is used in a study of attenuation and absorption of radiation by aspherical particles in the form of round and hexagonal cylinders. Expressions are also derived for computing the radiation attenuation and absorption efficiency factors for optically "soft" hexagonal prisms with an arbitrary orientation of their axis relative to the incident ray. It was found, for example, that the difference between a prism and round cylinder, and between particles of the same configuration but with different ratios of axes, is manifested most clearly for nonabsorbing particles. Definite relations were obtained for round and hexagonal cylinders for various conditions and parameters. Figures 4; references 4: 3 Russian, 1 Western.

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Use of Statistical Methods for Predicting Hail Processes and Their Characteristics

[Article by L. M. Fedchenko, doctor of geographical sciences, and A. Kh. Kagermazov, Alpine Geophysical Institute]

[Abstract] Long series of radiosonde data for several stations in the Northern Caucasus and corresponding aerosynoptic information were used in computing the parameters and discriminant functions for an alternative hail forecast. The algorithm and program for computing the parameters of the atmosphere and clouds developed on the basis of these data constitute an improved variant of the algorithm and program given earlier by Kh.Kh. Kalazhokov, et al. in TRUDY VGI, No 56, 1985. The structure of the program was organized in such a way that computation of the key characteristics is accomplished in individual subprograms, which ensures its necessary universality. The same subprograms were used in computing all the atmospheric energy characteristics through the corresponding temperature, humidity and wind values. Such parameters as the condensation point of air particles at different levels, temperature distribution in a cloud, wet-bulb thermometer temperature, potential and pseudopotential temperature and other conservative characteristics are computed. Forty-five different thermodynamic and synoptic parameters of prognostic importance with respect to the physics of the considered phenomena were computed, as well as combined parameters used in preparing hail predictions by different methods. An evaluation of the parameters of hail processes is made using regression analysis, in whose implementation, in addition to thermodynamic parameters, use is made of those parameters reflecting the interaction between circulatory processes and relief in a region. The quality of predictions when using the described method is superior to the results obtained by the method now in use. The principal advantage of the method is its minimal dependence on the skills of the weatherman. This is attributable to the fact that the prediction model does not provide for the construction of a convection model, which results in subjective errors in computation of the used thermodynamic characteristics of cloud convection. References 14: 13 Russian, 1 Western.

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Regional Model of Atmospheric Transport of Polydisperse Admixture

[Article by V. A. Borzilov, N. S. Veltishcheva, N. V. Klepikova and M. A. Novitskiy, candidates of physical and mathematical sciences, A. I. Burkov and L. M. Metelkina, Experimental Meteorology Institute; USSR Hydrometeorological Scientific Research Center]

[Abstract] A numerical model of regional transport of a polydisperse admixture from an instantaneous source is described. In order to improve spatial resolution a finite difference equation was solved in a moving Euler grid. In solving the problem allowance was made for spatial-temporal variability of the wind speed field and the field of turbulent diffusion coefficients. The parametrization of the atmospheric boundary layer is based on the drag and heat exchange laws and also on the relations of similarity theory. Standard meteorological data were used as the input parameters for the atmospheric boundary layer model. The influence of different initial meteorological fields on the transport and dispersal of the admixture was investigated. The results of numerical experiments with modeling of transport and settling of an admixture on the underlying surface are outlined. A merit of the model is that in addition to the variability of large-scale processes it takes into account atmospheric boundary layer dynamics as a function of external parameters. The use of a numerical solution of the equation for transport of an admixture made possible a more correct description of the wind shear effect and the introduction of a moving Euler grid with intervals increasing with cloud growth made it possible to attain a good spatial resolution of the cloud of particles regardless of its initial size. The use of meteorological data regularly received at regional centers as the input information affords possibilities for its operational use. Figures 2; references 11: 6 Russian, 5 Western.

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Joint Monitoring of Geopotential and Temperature Using Level-II FGGE Data

[Article by A. D. Naumov, USSR Hydrometeorological Scientific Research Center]

[Abstract] The results of multivariant checking of level-IIb FGGE data obtained using the procedure of multivariant checking of aerological information used on an operational basis at the USSR Hydrometeorological Center are presented. (This procedure, static and horizontal statistical, for checking geopotential and temperature, is described in detail by V. A. Antsypovich in TRUDY GIDROMETTSENTRA SSSR, No 217, 1980.) Radiosonde communications from surface stations and ships received during the special FGGE period 21-28 January 1979 are given particular attention. Data were obtained on the distribution of serious errors in geopotential and temperature at the main isobaric surfaces and in the principal geographical regions of the northern hemisphere. The generalized results of this checking at 10 standard levels are given in several sketch maps and in a table. It was found that about 17 percent of the aerological telegrams contained no information on geopotential and about 19 percent lacked information on temperature at standard isobaric surfaces from 1000 to 100 gPa. The checking procedure makes it possible to fill in an approximately equal number of missing H and T values at the upper levels of the atmosphere 300 and 100 gPa (1-3 percent) and a considerably greater percentage

of T values at the low levels 1000 and 850 gPa (23 and 1.4 percent respectively). About 2-3 percent of the H and T values were corrected in the checking procedure. The study revealed that the described checking procedure makes it possible to detect serious errors associated with defects in measurement instruments, distortions in communication channels during data transmission and errors in data conversion. The elimination of such errors improves the quality of objective analysis and therefore improves forecasting. Figures 3; references 23: 16 Russian, 7 Western.

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Albedo of Snow, Ice and Water Determined From Observational Data and Model Computations

18650143 Obninsk GIDROMETEOROLOGIYA. SERIYA 37.21. METEOROLOGIYA. ALBEDO SNEGA, LDA I VODY PO DANNYM NABLYUDENIY I MODELNYKH RASCHETOV in Russian 1988 (signed to press 24 Feb 88) pp 1-52

[Monograph by K. Ya. Kondratyev, V I. Korzov and N. Ye. Ter-Markaryants, All-Union Scientific Research Institute of Hydrometeorological Information-World Data Center, Informatsionnyy tsentr VNIIGMI-MTsD, 52 pages, 510 copies]

[Abstract] The albedo of snow, ice and water are examined on the basis of observational data and model computations. The importance of development of methods for the parametrization of the albedo of snow, ice and water is demonstrated in relation to the development of numerical models of general circulation of the atmosphere and the theory of climate. Practical recommendations are given for computing the albedo of seas and estimates of snow-ice albedo feedback effects and data on the influence of albedo changes on climate are given. Among the subjects examined are; snow cover albedo; ice albedo; model computations of reflection from snow surface; dependence of albedo of oceans and seas on solar altitude and cloud cover; mean monthly albedo of oceans and seas; albedo of seas and oceans in presence of waves; influence of petroleum film on reflected radiation; albedo of lakes, reservoirs and ponds. In actualty, during recent years there have been few studies related to radiation reflected from a water surface. However, many studies have been made of the factors which govern the albedo of a water surface, tables of mean daily albedo for seas have been compiled, including for different quantities of lower-level cloud coverage, and methods for computing sea albedo have been developed. However, there is a need for further detailed research on the reflection of radiation from a water surface, especially studies related to the influence of cloud cover and atmospheric turbidity. The reliable solution of parametrization problems is possible only on the basis of accumulation and generalization of considerably more complete files of observational data and
detailed study of the dependence of albedo on different factors. Figures 9; references 118: 55 Russian, 63 Western.

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Geodetic Research Using Artificial Earth Satellites

18650146a Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 4, Apr 88 pp 39-42

[Article by N. Georgiyev and D. Zhekov (Bulgarian People's Republic)]

[Abstract] Research using artificial earth satellites has been carried out in Bulgaria since 1957 (much of this article is devoted to a review of Bulgarian work in this field during the period 1957-1981). The beginning of space geodesy in Bulgaria began with the launching of the "Intercosmos-Bolgariya-1300" satellite on 7 August 1981, which carried 11 space research instruments and the OLSS optical laser light- reflecting system (a photograph of which accompanies the text), whose main purpose was laser sounding from surface observation stations. Theoretical and experimental research was carried out with the OLSS for finding an optimal design (optical system directional diagrams 23,", weight 4.35 kg, operating range from minus 80 to plus 160°C). During the first observation period alone 74 visual, photographic and laser stations throughout the world participated in the observations. Immediately after launching the laser reflector made it possible to make a more precise determination of the coordinates of surface stations and investigate the influence of the high atmosphere on the motion of such satellites. After successful completion of the OLSS experiments laser reflectors were ordered by the Soviet Union for use on "Meteor" and other satellites. In 1983 the artificial earth satellite station was moved to the "Plana" geodetic observatory, whose instrumentation included the "Intercosmos" laser satellite range finder, ULIS-60 universal laser measurement station (also illustrated by a photograph), atomic frequency standards, transit instrument, zenith telescope, computers and other auxiliary equipment (most of which were supplied by the Soviet Union). The first experimental copy of the ULIS-60 was installed at the "Plana" observatory in 1986 and is being used by Bulgarian and Soviet researchers in many experiments whose results will be taken into account in the standard production of the range finder, which has been ordered by several socialist countries. Using the ULIS-60 range finder the Central Higher Geodesy Laboratory drew up the IDEAL Project (Research on Dynamics of the Eurasian Lithosphere) for study of the regional geodynamics of the socialist countries. All "Intercosmos" stations will participate in this program. It is hoped that these observations will yield data on movement of tectonic plates in this seismic region. Figures 3.

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Some Results of Use of Space Survey Materials in Cartographic Work

18650146b Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 4, Apr 88 pp 42-44

[Article by Ye. A. Reshetov]

[Abstract] There are four principal areas in which space photographs and products of space surveys are used, each of which are reviewed in this article: compilation and revision of topographic maps; compilation of topographic bases for various kinds of maps; mapping of natural resources; specialized interpretation of photographs. Analytical phototriangulation, based on data on orbital motion of artificial earth satellites, has been used in establishing a survey base over extensive territories inaccessible for aerial surveys or surface field work. During the last five years survey networks for compilation and revision of topographic maps have been constructed over an area of 2.5 million square kilometers at considerably reduced cost. During the Eleventh Five-Year Plan new topographic maps for an area of 3.8 million square kilometers were produced and maps covering an area of 8.2 million square kilometers were revised. A great number of map bases has been put at the disposal of different branches of the economy; their quality is constantly improving. During the last five years many advances were made in using space materials in the study of natural resources, including preparation of geological maps, study and mapping of the shelf, land and forest resources, monitoring of seismic, avalanche and mudflow areas, research on the dynamics of natural processes and preservation of the environment. During the last five-year period natural resources maps for an area of a million square kilometers were produced at costs much less than for those prepared in the past by traditional methods. There is a great demand for space photographs and the products prepared from them: during the last five years requests have been received from 835 organizations, 300 of which are systematic users. During the Twelfth Five-Year Plan the volume of topographic work based on space materials will increase by a factor of 2-2.5 and there will be a considerable increase in the use of these materials in small-scale mapping and in the compilation of general-purpose maps and atlases.

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Full and Selective Initialization in Spectral Atmospheric Models

18650149a Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 3, Mar 88 (manuscript received 3 Mar 87) pp 5-16

[Article by A. A. Ilin and A. N. Filatov, corresponding member, Uzbek Academy of Sciences, USSR Hydrometeorological Scientific Research Center]

[Abstract] In atmospheric spectral models the eigenvalues of the spectrum of a linear model are broken down into two groups corresponding to the frequencies of gravity waves and Rossby waves. The initialization problem is solved as a problem in the choice of the initial fields in such a way that the asymptotic expansion of the solution of the corresponding spectral model of the atmosphere does not contain rapidly oscillating terms. It is shown that in any finite time interval initialization is always possible and rapid oscillations can be suppressed in any first N terms of an asymptotic expansion. Initialization in an infinite time interval and selective (partial) initialization are also discussed. References 10: 4 Russian, 6 Western.

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Influence of Radiation Regime Changes on Air Temperature at Land and Ocean Surface

18650149b Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 3, Mar 88 (manuscript received 14 Apr 87) pp 17-28

[Article by M. L. Asaturov, candidate of physical and mathematical sciences, State Hydrological Institute]

[Abstract] In an earlier study (METEOROLOGIYA I GIDROLOGIYA, No 2, 1988) the author proposed an energy balance model describing the seasonal changes in air temperature at the land and ocean surface and also different components of the northern hemisphere heat balance. In this article it is shown that the model can be used for evaluating changes in the Earth's thermal history after large releases of aerosol into the stratosphere which over a period of several months to several years can cause a considerable decrease in the quantity of solar radiation reaching the Earth's surface. The properties of this model are investigated, followed by computations of air temperature changes at the land and ocean surface in the northern hemisphere. The patterns of influence of large releases of aerosol into the stratosphere (as a result of explosive volcanic eruptions, collisions of asteroids with the Earth or nuclear war) on changes in the Earth's thermal regime are then analyzed. It is shown that the greater the quantity of aerosol entering the atmosphere, the greater is the air temperature decrease during both the first year and during subsequent years. In the case of very large escapes of aerosol, as in a nuclear war, a climatic catastrophe can occur: a severe cooling, especially on land, during the first year (most importantly, during the growing season), accompanied by anomalously low mean annual temperatures during the next 5-10 years. Figures 3; references 6: 4 Russian, 2 Western.

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Research on Ice-Forming Efficiency of AgI and PbI2 Pyrotechnic Nucleants in Stratiform Clouds

18650149c Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 3, Mar 88 (manuscript received 6 Apr 87) pp 41-47

[Article by M. Ya. Aksenov, T. V. Bazzayev, B. N. Leskov and N. O. Plaude, candidates of physical and mathematical sciences, Central Aerological Observatory; Ukrainian Regional Scientific Research Institute]

[Abstract] Small-caliber (26 mm) pyrotechnic shells loaded with ice-forming pyrotechnic AgI and PbI2 nucleants were tested in Ac, St and Sc clouds in experi-

ments carried out from Yak-40 and Il-18 aircraft. The tests were carried out in two winter seasons (1981-1982) by the Central Aerological Observatory and the Ukrainian Regional Scientific Research Institute. An industrial preparation containing 2 percent AgI and the earlier used 50 percent PbI2 preparation were tested in 24 parallel experiments. The experiments were carried out at cloud layer temperatures from -9 to - 29°C. It was found that a preparation with 2 percent AgI has a higher ice- forming activity in the range of low supercoolings (-9...-15°C). The lead iodide preparation exhibits a lower temperature threshold of the effect, but with a decrease in cloud temperature the effectiveness of the preparation increases rapidly and at temperatures below -20° the crystallization zone which it generates has a greater width than the zone generated by a 2 percent AgI preparation when equal quantities of AgI and PbI2 are used. It is shown that the use of the new 2 percent AgI preparation is equally effective as the previously used 50-60 percent Pb2 and has a higher crystallizing activity in the important range of low cloud supercoolings. Figures 3; references 11: 9 Russian, 2 Western.

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Water Temperature Change Below Active Layer in North Atlantic Ocean

[Article by D. I. Antonov and P. Ya. Groysman, candidate of physical and mathematical sciences, State Hydrological Institute]

[Abstract] The full archives of bathometric observations for the period of instrumental observations was processed for evaluating changes in thermal structure at depths below 300 m in the North Atlantic and a comparison of these changes with observed global warming and cooling processes. The data were taken from the World Data Center, where data for 300 000 oceanographic stations are stored, but the only data used were for the 113 000 stations for which measurements at horizons below 300 m are available (the 300-m horizon is the lower boundary of the active layer). Procedures were developed for eliminating the influence of the spatial variability of water temperature fields on the results of subsequent analysis by their transformation into temperature anomaly fields. A statistical analysis revealed statistically significant trends in change of mean water temperature at depths to 2000 m. It is postulated that these are attributable to the low-frequency component of the global warming process transpiring in the lower layers of the atmosphere. The results indicated that the accumulated body of bathometric observations can be used for studying large-scale patterns of recent changes in the thermal regime of the deep ocean, the most inertial link in the climatic system. It is suggested that time series of spatially averaged water temperature in the deep ocean obtained using procedures similar to those described in this article may be useful in more precise determination of the parameters of models describing heat propagation in the ocean. Figures 3; references 12: 5 Russian, 7 Western.

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Sound Radiation by Eddies, Acoustic Instability and Acoustic Collapse

[Article by V. M. Gryanik, Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] Sound is generated by nonstationary eddy movements in a compressible fluid. In exploring this phenomenon a study was made of the influence of weak compressibility of a medium (M 1, M is the Mach number) on evolution of localized eddy fields in systems with impaired (by flows, boundaries) translational invariance. Simple two-dimensional models are used in demonstrating that in such a system there may be acoustic instability and acoustic collapse caused by sound radiation by eddies. In particular, it is shown that free eddies can be drawn to fixed eddies if their vorticities are opposite in sign. A study was also made of the conditions under which free eddies are drawn to inhomogeneous rigid boundaries bounding the eddy current region. The necessary condition for collapse is the existence of such eddies opposite in sign; this requirement is also met by interaction of eddies of the same sign with a boundary. Among the effects of acoustic instability and collapse are: an explosive growth of the potential component of the current; in a two-dimensional case, a tendency to transfer of energy of a current in the spectrum in the direction of large wave numbers; acoustic stabilization of eddy currents when solid boundaries are present. The constructed models show that the acoustic instability mechanism has a universal character and has a definite analogue in electrodynamics. References 17: 14 Russian, 3 Western.

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Accuracy of Refractometric Method in Horizontally Inhomogeneous Atmosphere

[Article by M. Ye. Gorbunov, Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] An algorithm for solving the inverse problem in atmospheric refraction was proposed earlier by the author in IZV. VUZov: RADIOFIZIKA, No 11,

pp 1259-1300, 1987. This article essentially represents a continuation of this previous study, with emphasis on the requirements imposed on the system for attaining a definite accuracy and resolution. The following factors limiting accuracy and resolution are examined in detail: interpolation errors, finite number of measurements; random measurement errors. Only horizontal resolution is taken into account. Sensitivity of the algorithm to interpolation errors was checked in a numerical experiment and the optimal grid interval was determined. A formula was derived for estimating limiting resolution and on this basis a program was written for applying the full retrieval algorithm. It is shown that the algorithm makes it possible to improve horizontal resolution of the refractometric method in comparison with the local spherical symmetry approximation used previously. Figures 2; references 8: 7 Russian, 1 Western.

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Computation of Nonlinear Energy Transfer in Spectrum of Wind Waves

[Article by V. A. Kalmykov, candidate of physical and mathematical sciences, Atmospheric Physics Institute]

[Abstract] Computations of the nonlinear transfer of wave energy are made on the basis of the kinetic equation for waves in deep water. The computations were made using model JONSWAP spectra and angular wave spectra narrower than used in earlier studies. It is shown that in this case wave energy is transferred from the region of the spectral maxima to the upper and lower frequencies, as was also found earlier. For narrow angular spectra the energy transfer to the low frequencies decreases. A study was made of the interaction of two wave systems (swell and wind waves). The work is a further development of that done by A. Masuda ("Nonlinear Energy Transfer Between Wind Waves," J. PHYS. OCEANOGR., Vol 10, No 10, 1980). Computations were made for three types of spectra, giving many results consistent with Masuda's work, but also revealing earlier unknown facts. For example, when the spectrum contains two systems of waves with different directions of movement, not differing very greatly from one another, energy transfer is from wind waves to swell (of a lower frequency than wind waves), not vice versa, as might be expected. Figures 3; references 11; 1 Russian, 10 Western.

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Statistical Model of Dependence of Apple Yield on Agrometeorological Conditions

[Article by V. N. Petrushin and Yu. I. Chirkov, professor, Michurin Fruit and Vegetable Institute; Moscow Agricultural Academy]

[Abstract] Multiyear experimental data from agrometeorological and phenological observations in so-called dwarf orchards (age 1-20 years) and mathematical statistics and mathematical analysis methods were used in formulating a recurrent statistical model of the dependence of orchard yield (Borovinka-Budagovskiy Paradizka stock combination) on the agrometeorological parameters of the current and preceding year and the yield of the preceding year. The study data were for 1984-1986 and were compared with data for 1965-1983. More than a thousand measurements were analyzed. The influence of each significant agrometeorological factor was analyzed, such as the total of mean diurnal air temperatures during the growing season, mean diurnal soil temperatures at a depth of 20 cm, mean 10-day relative humidities, mean 10-day productive moisture reserves in the meter soil layer during the growing season and receipts of photosynthetically active radiation. An analysis of all these and other data revealed that apple trees most frequently suffer from a heat deficit, resulting in a lengthening of the time required for development of reproductive organs, and to a lesser degree from a shortage of reserves of productive moisture in the soil. The most important factor is relative humidity and a change in the receipts of photosynthetically active radiation is the least important. On the basis of this statistical analysis a method is proposed for predicting the yield of fruit trees at any particular time on the basis of observational data for the current year and mean multiyear values of agrometeorological factors. The method is illustrated in an example based on a 22-year series of observations and it is shown that the mathematical model gives satisfactory results. Similar models can be formulated for other stock combinations. References: 20 Russian.

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